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REF ID: A64382

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UNITED STATES ATOMIC ENERGY COMMISSION

A SUMMARY OF THE FISSION PRODUCT METABOLISM STUDIES

To March 1944

University of California

Radiation Laboratory

March 30, 1944

[REDACTED]

CLASSIFICATION CANCELLED
DATE 3/30/57
For The Atomic Energy Commission
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Chief, Declassification Branch

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Date Received August 26, 1949

Date Issued September 12, 1949

Sent 12/28/49 LF

A SUMMARY OF THE FISSION PRODUCT METABOLISM STUDIES

Up to March 1944

The metabolic properties of the carrier free long lived fission products in the adult rat have been investigated at different intervals ranging from one to sixty-eight days following administration of the radioactive material. The radio elements studied include the most important long lived fission products, namely, Sr, Y, Zr, Cb, Ru, I, Xe, Cs, Ba, La, Ce, Pr, Np, and the unseparated uranium free fission mixture. The routes of administration included intraperitoneal, intramuscular, oral and intrapulmonary. The tissues assayed for the distribution of the administered radio elements included heart, liver, kidney, testes, spleen, muscle, skin, stomach, small intestine, large intestine, bone, blood, lungs, brain, fat, adrenals, lymph nodes. Urine and feces were collected separately at daily intervals for assay.

The rats were injected and sacrificed in groups of three for each time interval and the tissues of each group assayed separately and the measured results averaged. All tissue samples were weighed before ashing so as to obtain the distribution per gram wet weight as well as the per organ distribution of the administered radio-element. The entire organ was assayed as a unit for all of the tissues with the exception of muscle, blood, and fat. The entire skin was assayed as a unit in the lung experiments. In the case of bone, the femur and tibia were assayed as well as the remainder of the entire skeleton and the per gram activity of bone as shown in the following table was calculated from the wet weight of the femur and tibia. The ashed samples were all weighed individually so that the proper correction for mass absorption could be made. Each sample was measured at least twice on either an electroscope or Geiger Counter. The per organ data was found to be more consistent than the per gram values and was probably due to variations in both animal size and ratio of the weights of the various organs to the weights of the animals.

The accompanying tables summarize the most pertinent results obtained from these studies. The tissues listed were selected from the original data because of either an initial high uptake or a prolonged retention of the administered radioactive material to such a degree that it is deemed important for the practical consideration of the health hazards of the fission products.

For the fission products which were poorly absorbed from the site of both intramuscular and intraperitoneal injection (namely, Y, Zr, Cb, Ru, La, Ce, Pr, Np, and the uranium free fission mixture) only the intramuscular data are given here and it is expressed in terms of the distribution of the fraction absorbed from the site of injection. For the radio elements which are completely absorbed following intraperitoneal and intramuscular injection or are absorbed in the digestive tract the distribution is expressed in terms of the administered dose. Due to the difficulty of introducing an exactly known dose into the lungs the distribution in this series of experiments is expressed as distribution of retained activity within the animal. A total of 510 animals were used and 10,500 samples assayed with at least two measurements made on each sample. The average measured recovery of the administered dose in the tissue and excreta was 103.6%.

In addition to these experiments a large series of radio-autographs of lung tissue were made at different times following the intrapulmonary administration of Y, Zr, Cb, Ru, Ce, Np, and the fission mixture. Detailed histological studies of the sections and careful examination of the radio-autographs under the microscope revealed that these radio elements were deposited principally in the alveolar structure of the lung. No significant deposition and retention of radioactive material was observed in the blood vessels, bronchial tree, and lymphoid tissue of the lung.

ELEMENT - STRONTIUM (Sr⁸⁵) ADMINISTERED IN SOLUTION AS SrCl₂ROUTE OF ADMINISTRATION - INTRAPERITONEAL

Values Indicate Distribution of Administered Activity

Time in Days Following Administration

Tissue	One Day		Four Days		Sixteen Days		Sixty-Four Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	70.2	4.7	61.7	3.8	50.4	3.3	43.3	2.1
Muscle	1.22	.011	.36	.003	.098	.0008	.90	.006
Skin	.97	.020	.45	.007	.18	.004	.062	.001
Blood	.32	.016	.12	.004	.024	.001	.008	.0003

Rate of excretion equivalent to half-time in body of ~ 200 days.

ROUTE OF ADMINISTRATION - ORAL

Values Indicate Distribution of Administered Activity (absorption 15% of administered dose)

	One Day		Four Days		Sixteen Days		Sixty-Four Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	7.4	.57	9.4	.71	11.1	.69	10.9	.52
Muscle	.71	.007	.40	.004	.042	.0004	.070	.0005
Skin	.58	.015	.20	.006	.058	.001	.032	.0005
Blood	.20	.011	.58	.033	.012	.0006	.006	.0002

Recovery of Administered Dose in Tissues 97.0%

Rate of excretion of absorbed dose equivalent to half time in body of ~200 days.

ROUTE OF ADMINISTRATION - INTRAPULMONARY

No significant lung retention.

Total Number of Animals Used 30

Total Number of Tissue Assays 750

ELEMENT - YTTRIUM (Y^{88}) ADMINISTERED IN SOLUTION AS YCl_3

ROUTE OF ADMINISTERED - INTRAMUSCULAR

Values Indicate Distribution of Absorbed Activity

Time in Days Following Administration

	One Day		Four Days		Sixteen Days		Sixty-Four Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	58.3	3.26	58.2	2.70	68.3	3.63	63.3	1.78
Liver	9.56	1.20	5.18	.41	1.52	.14	.38	.04
Kidney	2.58	1.36	2.19	.82	1.84	.68	.48	.20
Spleen	.23	.31	.31	.25	.30	.25	.12	.15

Recovery of Administered Dose in Tissues 102.1%

Rate of Excretion Equivalent to Half-Time in Body of ~500 Days.

ROUTE OF ADMINISTRATION - INTRAPULMONARY

Values Indicate Distribution of Retained Activity

	One Day		Four Days		Twenty-one Days		Thirty-two Days		Sixty-four Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	9.64	.48	39.0	2.12	72.4	3.33	85.2	3.89	83.4	3.30
Lungs	82.6	34.8	45.1	23.0	16.9	8.79	2.67	1.60	6.44	2.85
Liver	.95	.074	3.21	.26	1.47	.13	.78	.051	.42	.029
Kidney	.56	.22	2.03	.73	.99	.37	1.20	.39	.50	.16
Spleen	.054	.050	.14	.13	.16	.16	.28	.19	.20	.18

ROUTE OF ADMINISTRATION - ORAL

Absorption from Digestive Tract <0.2%

Total Number of Animals Used 66

Total Number of Tissue Assays 1,380

ELEMENT - ZIRCONIUM (Zr^{89} , Zr^{93}) ADMINISTERED AS A SOLUTION OF $ZrOCl_2$

ROUTE OF ADMINISTRATION - INTRAMUSCULAR

Values Indicate Distribution of Absorbed Activity

Time in Days Following Administration

Tissue	One Day		Four Days		Sixteen Days		Thirty-Two Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	2.38	.15	38.8	2.02	57.8	2.04	38.2	2.14
Liver	1.96	.17	4.51	.65	3.73	.35	2.37	.23
Kidney	.35	.19	2.63	1.36	1.60	.63	1.56	.67
Spleen	.051	.089	.62	.54	.49	.53	.25	.32

Recovery of Administered Dose in Tissues 104.4%

Rate of Excretion Equivalent to Half-Time in Body ~ 80 Days

ROUTE OF ADMINISTRATION - INTRAPULMONARY

Values Indicate Distribution of Retained Activity

	One Day		Four Days		Thirty-Two Days		Sixty-Four Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	10.2	.50	3.85	.21	16.3	1.08	16.3	.98
Lung	77.9	54.4	92.2	50.3	75.9	53.0	62.0	31.0
Liver	.82	.06	.36	.03	.50	.04	1.14	.12
Kidney	.13	.06	.20	.08	.29	.12	.60	.25
Spleen	.10	.10	.27	.38	.36	.50	.65	.96

ROUTE OF ADMINISTRATION - ORAL

Absorption from Digestive Tract <0.01%

Total Number of Animals Used 42

Total Number of Tissue Assays 900

ELEMENT - COLUMBIUM (Cb⁹³) ADMINISTERED IN SOLUTION AS CbOCl₃ROUTE OF ADMINISTRATION - INTRAMUSCULAR

Values Indicate Distribution of Absorbed Activity

Time in Days Following Administration

	<u>One Day</u>		<u>Four Days</u>		<u>Sixteen Days</u>		<u>Sixty-Eight Days</u>	
	<u>% Per</u>	<u>% Per</u>	<u>% Per</u>	<u>% Per</u>	<u>% Per</u>	<u>% Per</u>	<u>% Per</u>	<u>% Per</u>
	<u>Organ</u>	<u>Gram</u>	<u>Organ</u>	<u>Gram</u>	<u>Organ</u>	<u>Gram</u>	<u>Organ</u>	<u>Gram</u>
Bone	38.4	1.48	35.5	1.74	22.6	1.94	11.0	.85
Liver	8.91	1.40	7.29	1.47	4.54	.63	1.94	.29
Kidney	1.35	.92	1.54	1.35	1.54	.93	.93	.61
Spleen	.59	.78	.76	1.24	.66	.86	.34	.65
Blood	25.0	1.91	5.04	.50	1.33	.093	.39	.033

Recovery of Administered Dose in Tissues 102.5%

Rate of Excretion Equivalent to Half-Time in the Body ~ 50 Days

ROUTE OF ADMINISTRATION - INTRAPULMONARY

Values Indicate Distribution of Retained Activity

	<u>One Day</u>		<u>Four Days</u>		<u>Sixteen Days</u>	
	<u>% Per</u>	<u>% Per</u>	<u>% Per</u>	<u>% Per</u>	<u>% Per</u>	<u>% Per</u>
	<u>Organ</u>	<u>Gram</u>	<u>Organ</u>	<u>Gram</u>	<u>Organ</u>	<u>Gram</u>
Bone	6.75	.036	16.5	.89	18.9	1.36
Lung	75.7	62.1	58.3	50.4	51.3	40.9
Liver	1.02	.14	1.94	.29	4.03	.49
Kidney	.29	.17	.58	.40	1.38	1.00
Spleen	.05	.10	.23	.34	.54	.82

ROUTE OF ADMINISTRATION - ORAL

Absorption from Digestive Tract <1.0%

Total Number of Animals Used 51

Total Number of Tissue Assays 800

ELEMENT - RUTHENIUM ($Ru >^{104}$) ADMINISTERED AS A SOLUTION OF $RuCl_4$ ROUTE OF ADMINISTRATION - INTRAMUSCULAR

Values Indicate Distribution of Absorbed Activity

Time in Days Following Administration

	<u>Four Days</u>		<u>Sixteen Days</u>		<u>Sixty-four Days</u>	
	<u>% Per</u> <u>Organ</u>	<u>% Per</u> <u>Gram</u>	<u>% Per</u> <u>Organ</u>	<u>% Per</u> <u>Gram</u>	<u>% Per</u> <u>Organ</u>	<u>% Per</u> <u>Gram</u>
Bone	10.2	.29	5.32	.16	3.52	.051
Liver	2.88	.24	1.26	.13	.27	.015
Kidney	3.48	1.36	1.41	.67	.46	.14
Spleen	.44	.36	.33	.30	.068	.049

Recovery of Administered Dose in Tissues 102.9%

Rate of Excretion is Equivalent to Half-Time in Body ~ 20 Days.

ROUTE OF ADMINISTRATION - INTRAPULMONARY

Values Indicate Distribution of Retained Activity

	<u>Four Days</u>		<u>Sixteen Days</u>		<u>Thirty-Two Days</u>		<u>Sixty-Four Days</u>	
	<u>% Per</u> <u>Organ</u>	<u>% Per</u> <u>Gram</u>	<u>% Per</u> <u>Organ</u>	<u>% Per</u> <u>Gram</u>	<u>% Per</u> <u>Organ</u>	<u>% Per</u> <u>Gram</u>	<u>% Per</u> <u>Organ</u>	<u>% Per</u> <u>Gram</u>
Bone	2.45	.13	7.42	.37	7.29	.35	7.34	.30
Lungs	63.6	23.6	58.4	20.8	50.3	21.0	25.5	12.6
Liver	3.20	.20	2.95	.22	3.17	.25	2.65	.17
Kidney	4.73	1.36	7.59	2.38	4.01	1.37	4.47	1.41
Spleen	.70	.47	.75	.42	.54	.45	.43	.34

ROUTE OF ADMINISTRATION - ORAL

Absorption from Digestive Tract <0.01%

Total Number of Animals Used 36

Total Number of Tissue Assays 800

ELEMENT - IODINE (I^{131}) ADMINISTERED AS A SOLUTION OF NaI. (HUMAN STUDIES)

ROUTE OF ADMINISTRATION - ORAL

Absorption by way of the Digestive Tract 100%

Retention by Thyroid Gland of Normal Human Adults 20%

Rate of Excretion Exclusive of that in the Thyroid Equivalent to
Half-Time in Body <2 Days.

Rate of Loss from the Thyroid Equivalent to Half-Time in the Gland
> 30 Days.

ELEMENT - XENON (Xe^{127}) ADMINISTERED AS THE GAS

ROUTE OF ADMINISTRATION - INHALATION

Distribution at equilibrium proportional to Fat Content of Tissues
Ranging from 2.2 in Fat to 0.1 for Blood of the Concentration of
 Xe^{127} in the Inhaled Air.

Human Studies with Xe^{127} Done Elsewhere Indicate a Half-Period
for equilibrium for either Absorption or Excretion to be ~ 1 Hours.

ELEMENT - CESIUM (Cs¹³⁵) ADMINISTERED IN SOLUTION AS CsCl

ROUTE OF ADMINISTRATION - INTRAMUSCULAR

Values Indicate Distribution of Administered Activity - Time in Days Following Administration

Tissue	One Day		Four Days		Sixteen Days		Sixty-Eight Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	2.60	.35	3.02	.22	2.64	.14	.30	.017
Liver	5.72	.60	1.94	.23	.84	.10	.028	.0063
Kidney	1.03	.53	.43	.28	.29	.16	.010	.005
Spleen	.42	.46	.12	.13	.067	.11	.005	.009
Muscle	36.3	.48	29.8	.39	27.0	.31	1.89	.018

Rate of Excretion Equivalent to Half-Time in the Body of ~10 Days

ROUTE OF ADMINISTRATION - ORAL (Absorption 100% of Administered Dose)

Values Indicate Distribution of Administered Activity

	One Day		Four Days		Sixteen Days		Sixty-Eight Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	7.37	.43	3.46	.17	1.59	.091	.51	.0030
Liver	4.14	.58	2.04	.20	.79	.089	.035	.0046
Kidney	2.08	1.14	.48	.23	.17	.095	.0063	.0040
Spleen	.54	.66	.10	.10	.041	.062	.005	.008
Muscle	42.6	.54	19.6	.26	23.1	.27	1.58	.020

Average Recovery in Tissues of Administered Dose 95.4%

Rate of Excretion Equivalent to Half-Time in Body of ~10 Days

ROUTE OF ADMINISTRATION - INTRAPULMONARY

No Significant Lung Retention Noted.

Total Number of Animals Used 45

Total Number of Tissue Assays 1,200

ELEMENT - BARIUM (Ba¹³³, Ba¹⁴⁰) ADMINISTERED AS A SOLUTION OF BaCl₂

ROUTES OF ADMINISTRATION - INTRAMUSCULAR AND INTRAPERITONEAL

Values Indicate Distribution of Administered Activity

Time in Days Following Administration

Tissue	One Day		Four Days		Eight Days		Sixteen Days		Thirty-Two Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	54.2	4.39	59.6	3.68	60.3	4.96	59.5	3.26	49.1	3.51
Muscle	.25	.0033	.12	.0007	.56	.0065	.28	.0006	<.2	<.0002
Skin	.59	.015	.51	.0093	.26	.0072	.17	.0028	.090	.0025
Blood	.10	.0063	.036	.0017	.022	.0013	.022	.0009	<.01	<.0005

ROUTE OF ADMINISTRATION - ORAL

Values Indicate Distribution of Administered Activity (Absorption 10% of administered dose)

	One Day		Four Days		Eight Days		Sixteen Days		Thirty-Two Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	8.87	.31	4.51	.38	11.3	.66	9.82	.76	3.80	.29
Muscle	.049	.0005	.022	.0002	.54	.0058	.02	.0002	<.04	<.0004
Skin	.29	.007	.085	.0008	.070	.0028	.092	.0008	<.04	<.001
Blood	.009	.001	.006	.0004	.015	.0009	.003	.0003	<.006	<.0006

Average Recovery in Tissues of Administered Dose 107.5%

Rate of Excretion of Retained Activity for Both Routes of Administration Equivalent to Half-Time in Body ~200 Days.

Total Number of Animals Used 57

Total Number of Tissue Assays 1,250

ELEMENT - LANTHANUM (La¹⁴⁰) ADMINISTERED AS A SOLUTION OF LaCl₃

ROUTE OF ADMINISTRATION - INTRAMUSCULAR

Values Indicate Distribution of Absorbed Activity

Time in Days Following Administration

Tissue	One Day		Four Days		Eight Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	25.9	.91	42.4	1.48	30.5	1.36
Liver	69.8	6.61	48.4	4.31	23.2	2.26
Kidney	1.72	.95	1.60	.79	1.04	.48
Spleen	.18	.29	.12	.11	.11	.13

Recovery of Administered Dose in Tissues 105.2%

Excretion Rate Equivalent to Half-Time in Body >16 Days

ROUTE OF ADMINISTRATION - INTRAPULMONARY

Values Indicate Distribution of Retained Activity

	One Day		Four Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	27.5	1.5	10.7	.30
Lung	36.7	25.5	64.9	32.8
Liver	9.1	.70	12.3	1.0
Kidney			1.2	.40
Spleen			.20	.20

ROUTE OF ADMINISTRATION - ORAL

Absorption from the Digestive Tract <0.3%

Total Number of Animals Used 25

Total Number of Tissues Assayed 400

ELEMENT - CERIU (Ce^{140}) ADMINISTERED AS A SOLUTION OF $CeCl_3$

ROUTE OF ADMINISTRATION - INTRAMUSCULAR

Values Indicate Distribution of Absorbed Activity

Time in Days Following Administration

	One Day		Four Days		Sixteen Days		Sixty-Four Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	34.9	1.82	37.2	1.56	34.7	1.80	27.3	1.83
Liver	41.2	5.72	42.5	7.15	13.9	1.71	2.72	.51
Kidney	3.61	1.86	2.78	1.61	1.31	.72	.28	.22
Spleen	.42	.51	.27	.42	.21	.27	.15	.34

Recovery of Administered Dose in Tissues 100.2%

Excretion Rate Equivalent to Half-Time in Body ~ 50 Days.

ROUTE OF ADMINISTRATION - INTRAPULMONARY

Values Indicate Distribution of Retained Activity

	One Day		Four Days		Sixteen Days		Sixty-Four Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	14.0	.55	21.2	1.53	37.6	2.40	74.6	4.49
Lungs	66.5	52.7	49.5	29.3	35.3	21.6	9.43	8.76
Liver	14.6	1.73	16.3	1.66	18.2	2.53	7.04	1.43
Kidney	.58	.35	1.70	.92	.77	.47	.66	.53
Spleen	.048	.071	.080	.12	.17	.27	.20	.50

ROUTE OF ADMINISTRATION - ORAL

Absorption from the Digestive Tract <0.05%

Total Number of Animals Used 51

Total Number of Tissues Assayed 1,100

ELEMENT - PRASEODYMIUM (Pr¹⁴³) ADMINISTERED AS A SOLUTION OF PrCl₃

ROUTE OF ADMINISTRATION - INTRAMUSCULAR

Values Indicate Distribution of Absorbed Activity

Time in Days Following Administration

Tissue	One Day		Four Days		Sixteen Days		Thirty-Two Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	47.4	2.53	35.7	3.14	39.7	3.13	37.3	2.01
Liver	29.2	3.27	29.3	4.07	10.3	1.45	4.30	.45
Kidney	2.59	1.35	2.06	1.24	1.16	.68	.57	.25
Spleen	<.07	<.10	.07	.14	<.03	<.06	.08	.13

Average Recovery in Tissues of Administered Dose 107.%

Rate of Elimination Equivalent to Half-Time in Body ~ 40 Days.

ROUTE OF ADMINISTRATION - INTRAPULMONARY

Values Indicate Distribution of Retained Activity

	One Day		Four Days		Sixteen Days		Thirty-Two Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	18.0	.90	22.2	1.84	50.0	2.33	59.9	3.06
Lungs	58.7	57.6	48.3	40.3	21.9	17.6	9.32	5.90
Liver	17.2	2.54	20.1	2.27	18.2	1.58	3.24	.40
Kidney	2.04	1.15	1.72	.84	1.38	.59	.61	.34
Spleen	<.2	<.5	.08	.10	.13	.17	<.5	<1.0

ROUTE OF ADMINISTRATION - ORAL

Absorption from Digestive Tract <0.5%

Total Number of Animals Used 27

Total Number of Tissue Assays 500

ELEMENT - NEPTUNIUM (Np²³⁷, Np²³⁸) ADMINISTERED IN SOLUTION AS NpCl₃

ROUTE OF ADMINISTRATION - INTRAMUSCULAR

Values Indicate Distribution of Absorbed Activity

Time in Days Following Administration

Tissue	One Day		Four Days		Eight Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	57.1	2.22	47.5	2.30	48.3	2.18
Liver	5.02	.42	3.67	.41	2.85	.31
Kidney	2.42	1.04	1.09	.48	.83	.36
Spleen	.038	.042	.088	.064	.025	.041

Average Recovery of Administered Dose in Tissues 114.7%

Rate of Elimination Equivalent to Half-Time in Body >15 Days.

ROUTE OF ADMINISTRATION - INTRAPULMONARY

Values Indicate Distribution of Retained Activity

	One Day		Four Days		Eight Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	56.3	3.34	63.6	4.30	67.0	2.68
Lung	18.6	9.07	13.4	7.78	9.75	5.74
Liver	6.52	.53	4.52	.43	3.17	.22
Kidney	3.48	1.17	1.52	.70	.61	.24

ROUTE OF ADMINISTRATION - ORAL

Absorption from Digestive Tract <0.1%

Total Number of Animals Used 21

Total Number of Tissue Assays 300

ELEMENT - URANIUM FISSION MIXTURE ADMINISTERED AS A SOLUTION OF THE CHLORIDESROUTE OF ADMINISTERED - INTRAMUSCULAR

Values Indicate Distribution of Absorbed Activity

Time in Days Following Administration

Tissue	Four Days		Sixteen Days		Sixty-Four Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	48.9	2.27	45.9	1.74	39.7	1.21
Liver	14.0	1.53	6.72	.52	1.44	.11
Kidney	1.49	.63	.73	.27	.58	.20
Spleen	.13	.13	.19	.12	.13	.10

Excretion Rate Equivalent to Half-Time in Body ~80 Days.

ROUTE OF ADMINISTRATION - ORAL (Absorption 5% of Administered Dose)

	Four Days		Sixteen Days		Sixty-Four Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	3.85	.18	5.30	.14	2.38	.077
Liver	.030	.0022	.017	.0023	.011	.0011
Kidney	.0066	.0027	.0030	.0005	.007	.002
Spleen	.0066	.0045	.0030	.0033	.006	.006

Recovery of Administered Dose in Tissues for both routes of administration 103.9%
 Excretion Rate Equivalent to Half-Time in Body ~80 Days

ROUTE OF ADMINISTRATION - INTRAPULMONARY

	Four Days		Sixteen Days		Sixty-Four Days	
	% Per Organ	% Per Gram	% Per Organ	% Per Gram	% Per Organ	% Per Gram
Bone	35.8	1.99	60.7	3.38	73.8	4.09
Lungs	37.9	18.6	21.4	12.7	7.25	2.90
Liver	5.57	.36	7.43	.63	3.49	.22
Kidney	.59	.19	.74	.28	1.00	.31
Spleen	.05	.04	.12	.12	.24	.15

Total Number of Animals Used 48

Total Number of Tissues Assayed 1,400

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